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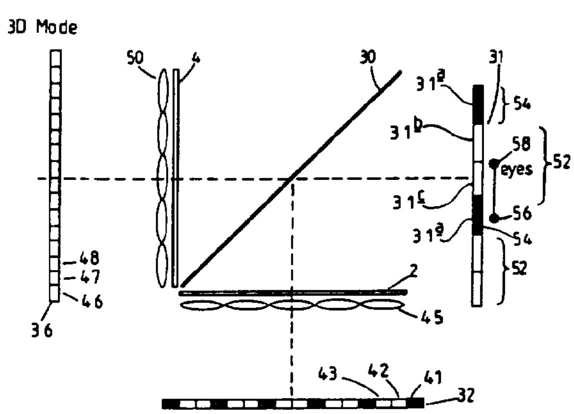
(54) Autostereoscopic display having a high resolution 2D mode

(57) An autostereoscopic display has first and second spatial light modulators 2, 4. Images from the spatial light modulators are combined by a beam combiner 30 before being presented to a viewing region 31. The relative positions of the first and second spatial light modulators 2, 4 are controlled such that pixels of the second spatial light modulator 4 are interspersed with pixels of the first spatial light modulator 2. Such an arrangement allows an effective doubling of resolution when the spatial light modulators are operated so as to produce a two dimensional image instead of a three dimensional image.

FIG 6a



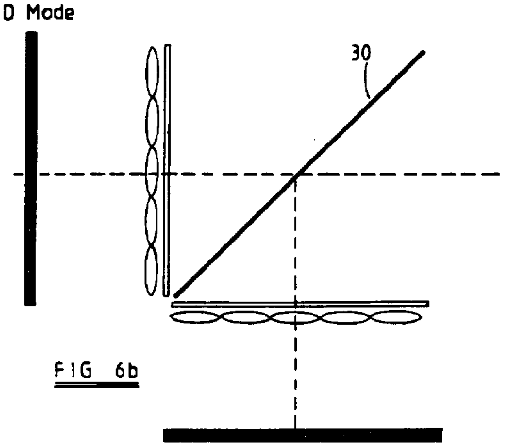


FIG 6b

GB 2 296 400 A

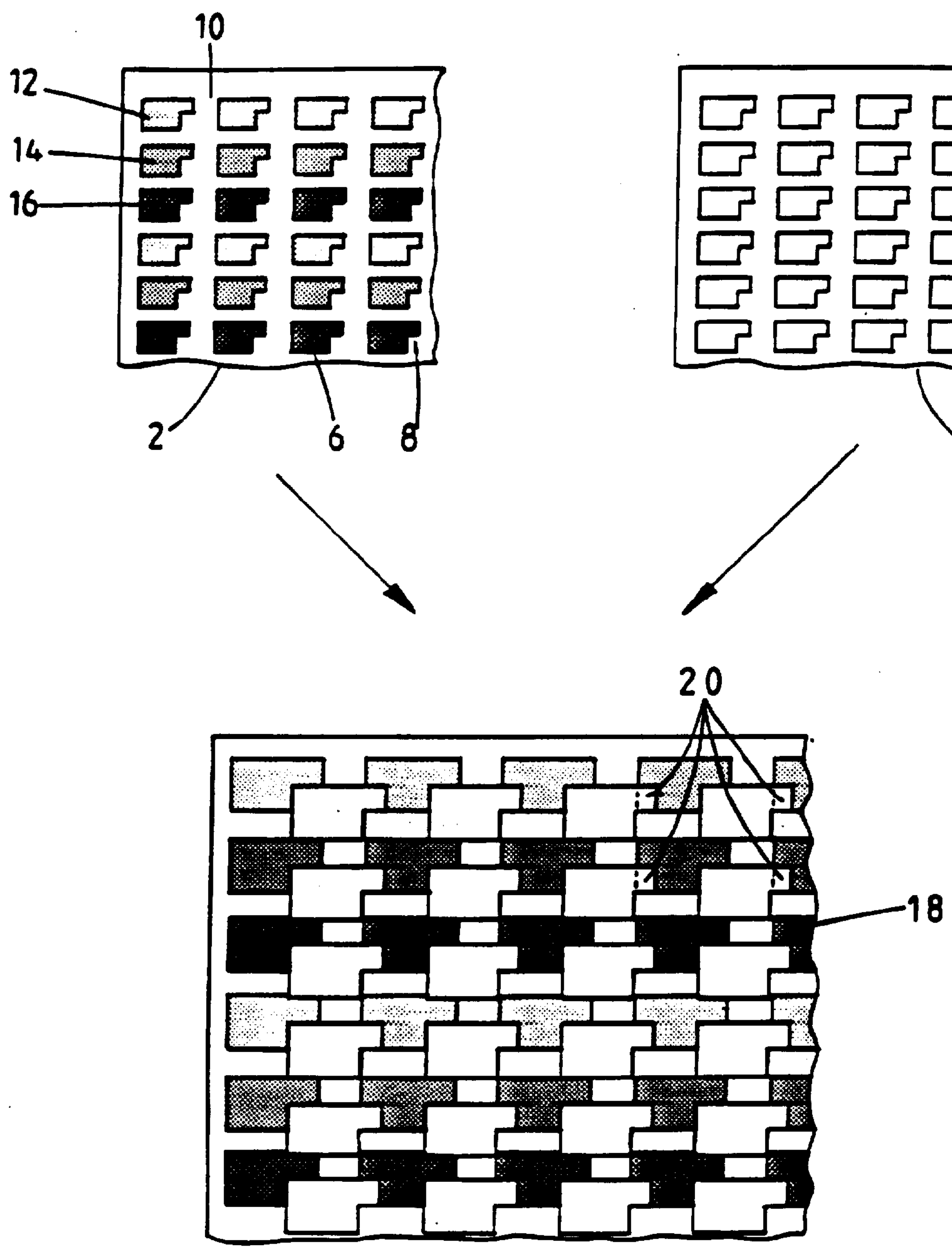


FIG 1

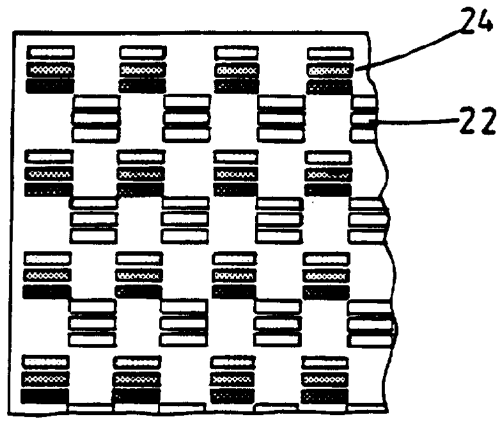


FIG 2

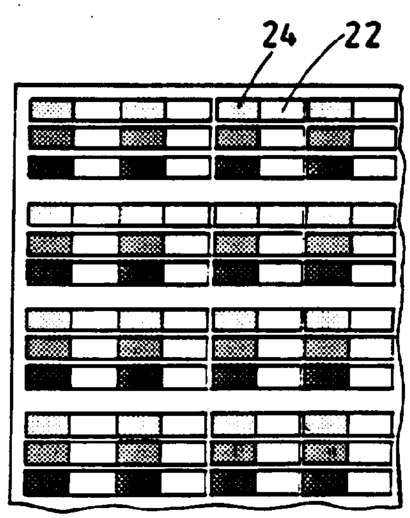


FIG 4

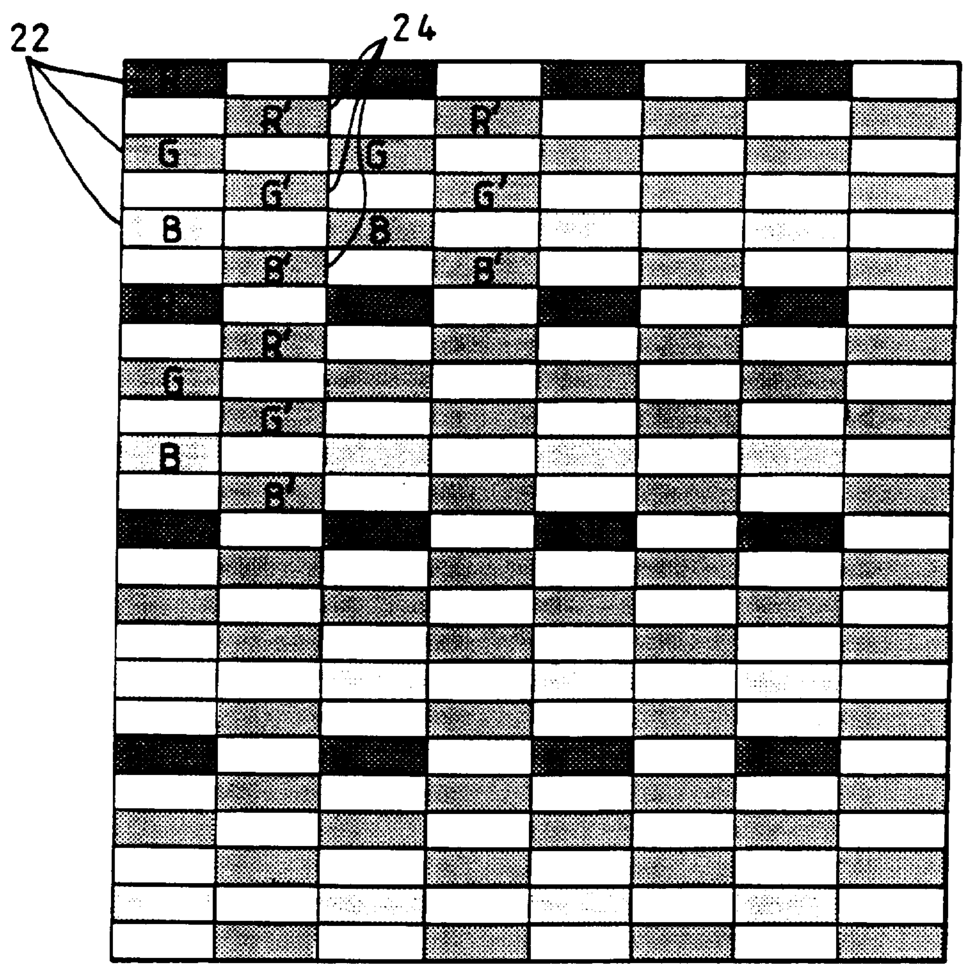


FIG 3

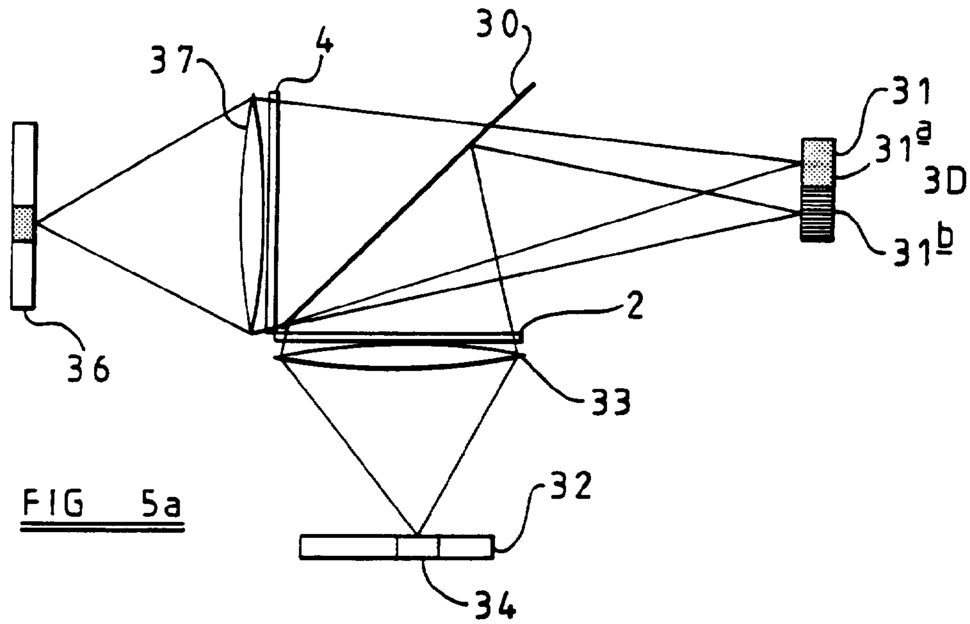


FIG 5a

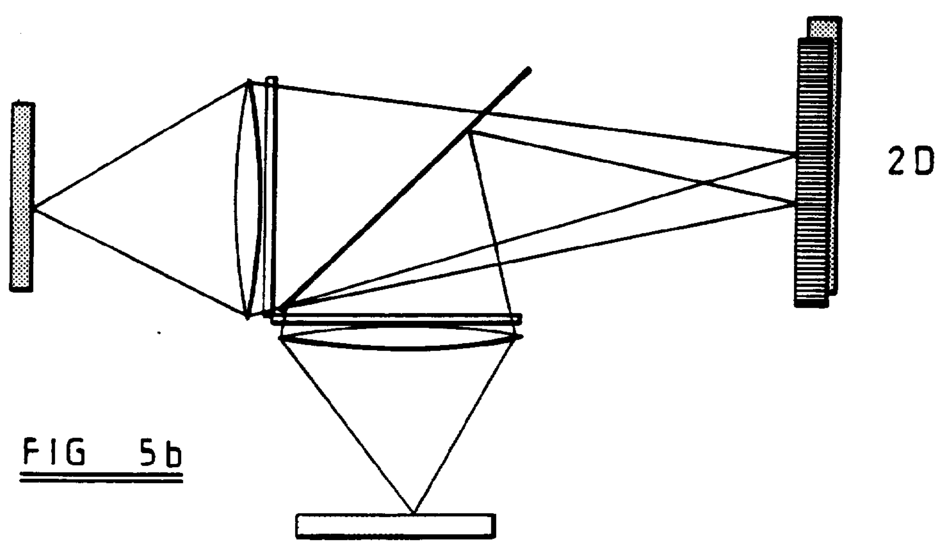
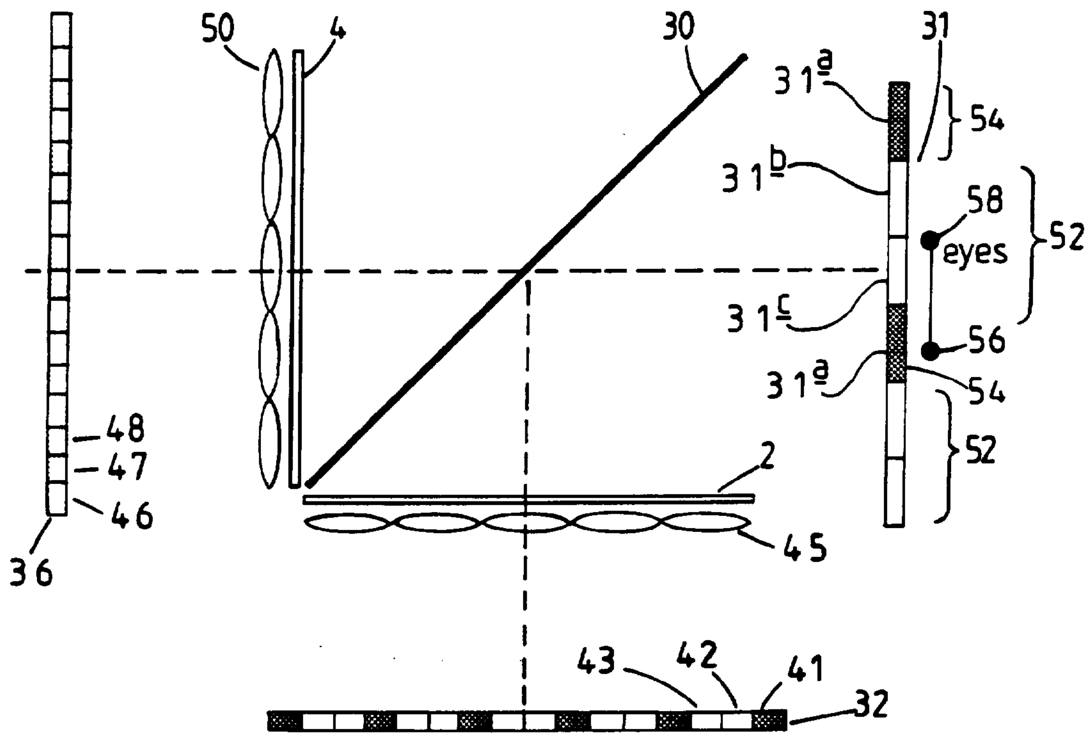


FIG 5b

FIG 6a

3D Mode



2D Mode

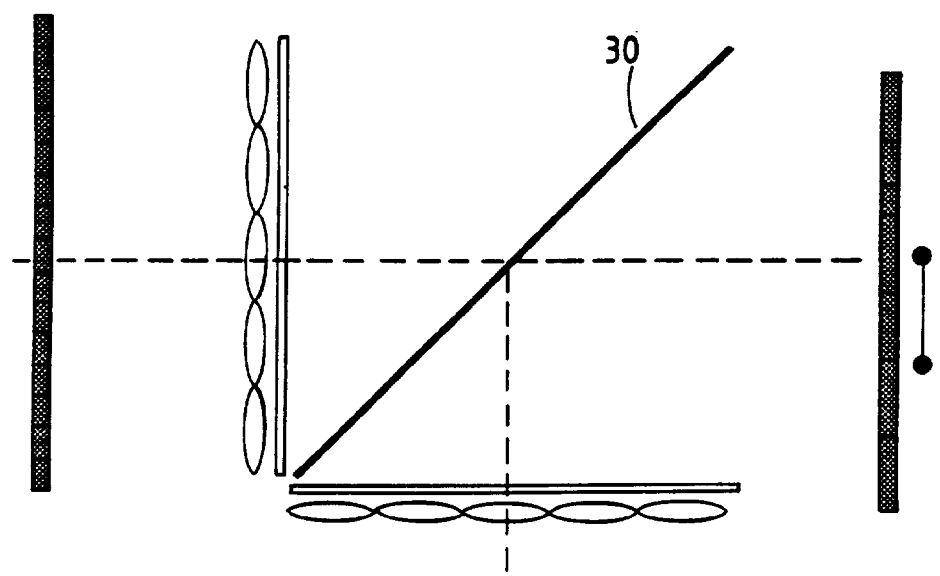


FIG 6b

3D Mode

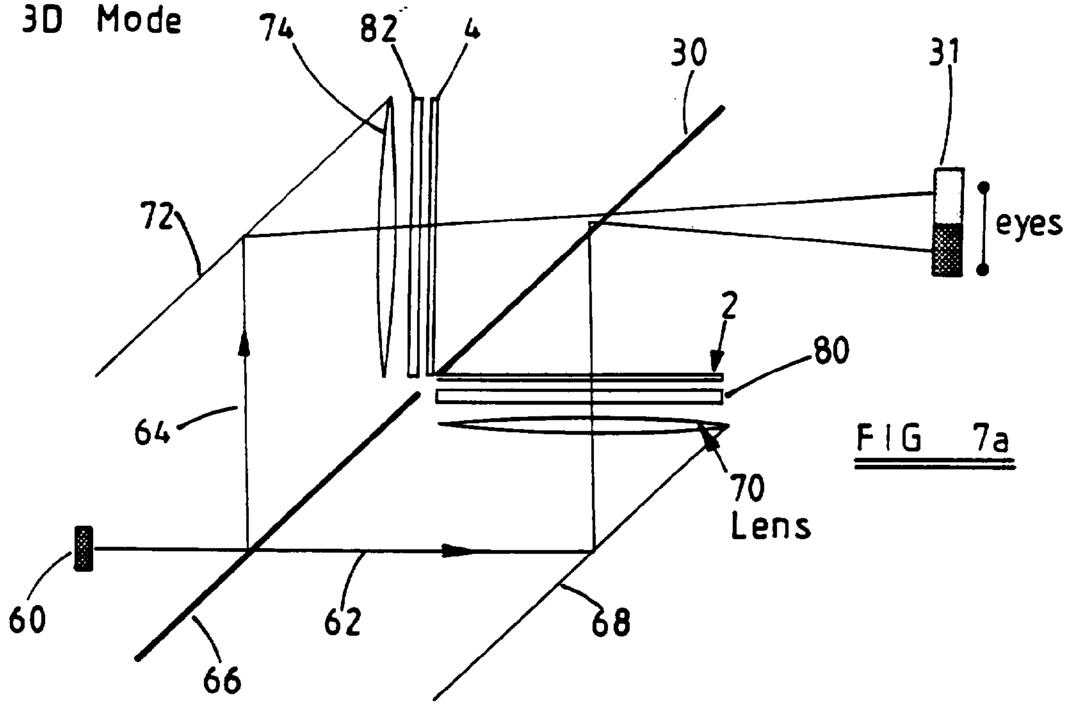


FIG 7a

2D Mode

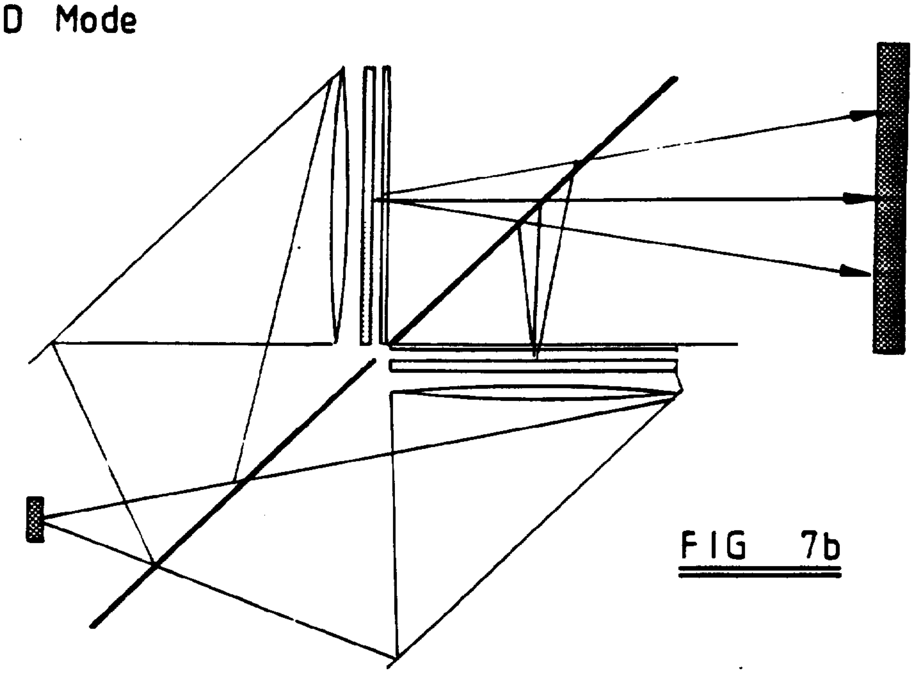
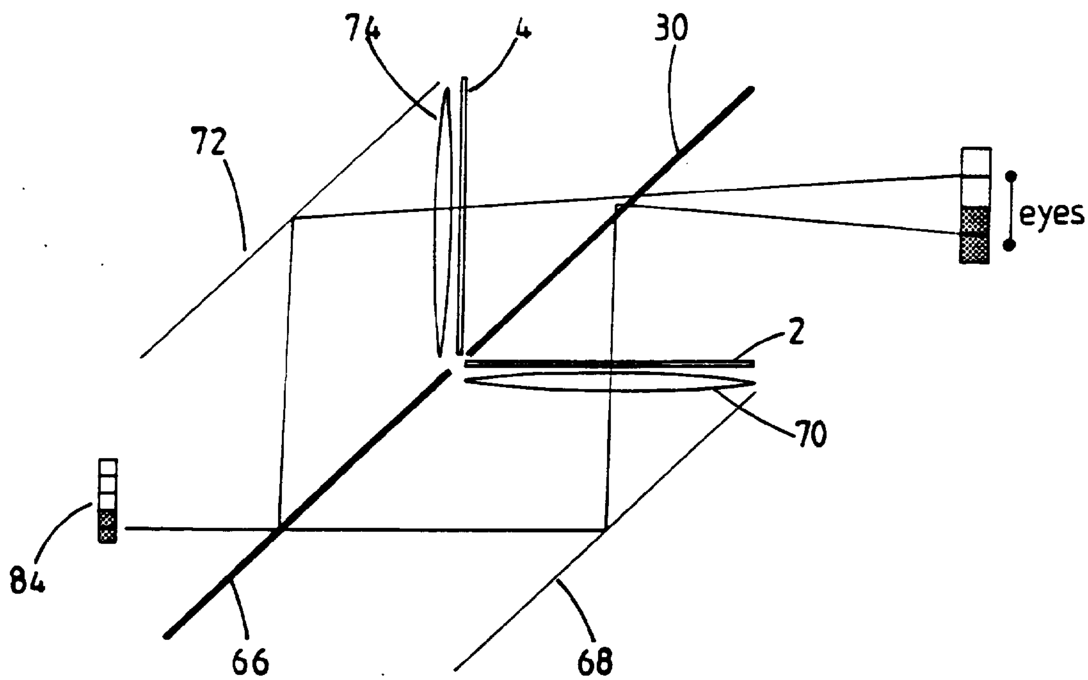


FIG 7b

FIG 8a

3D Mode



2D Mode

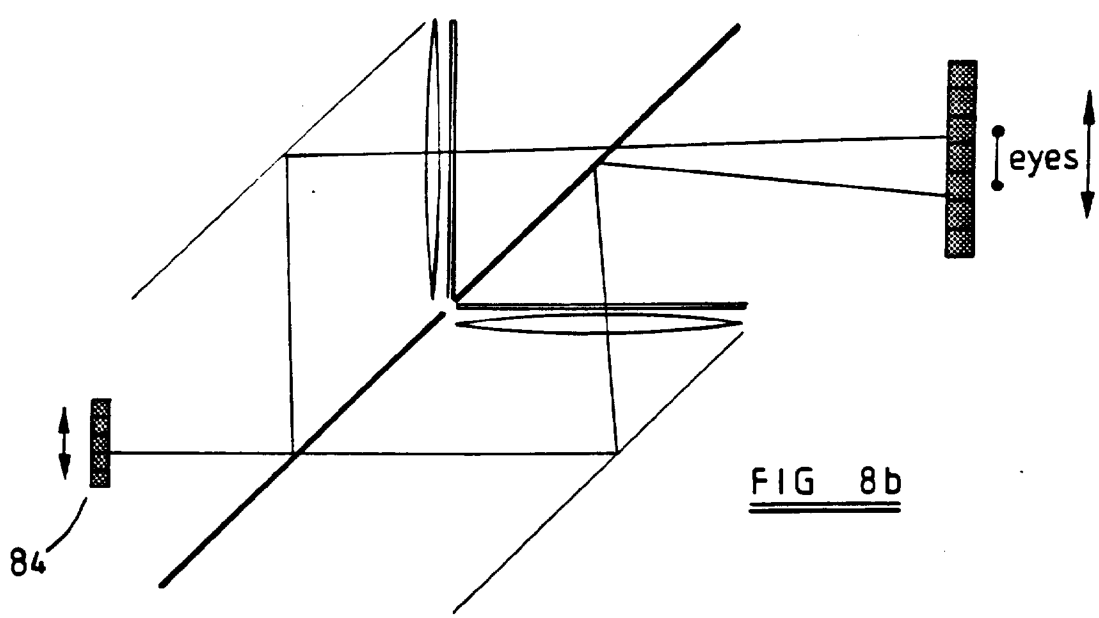
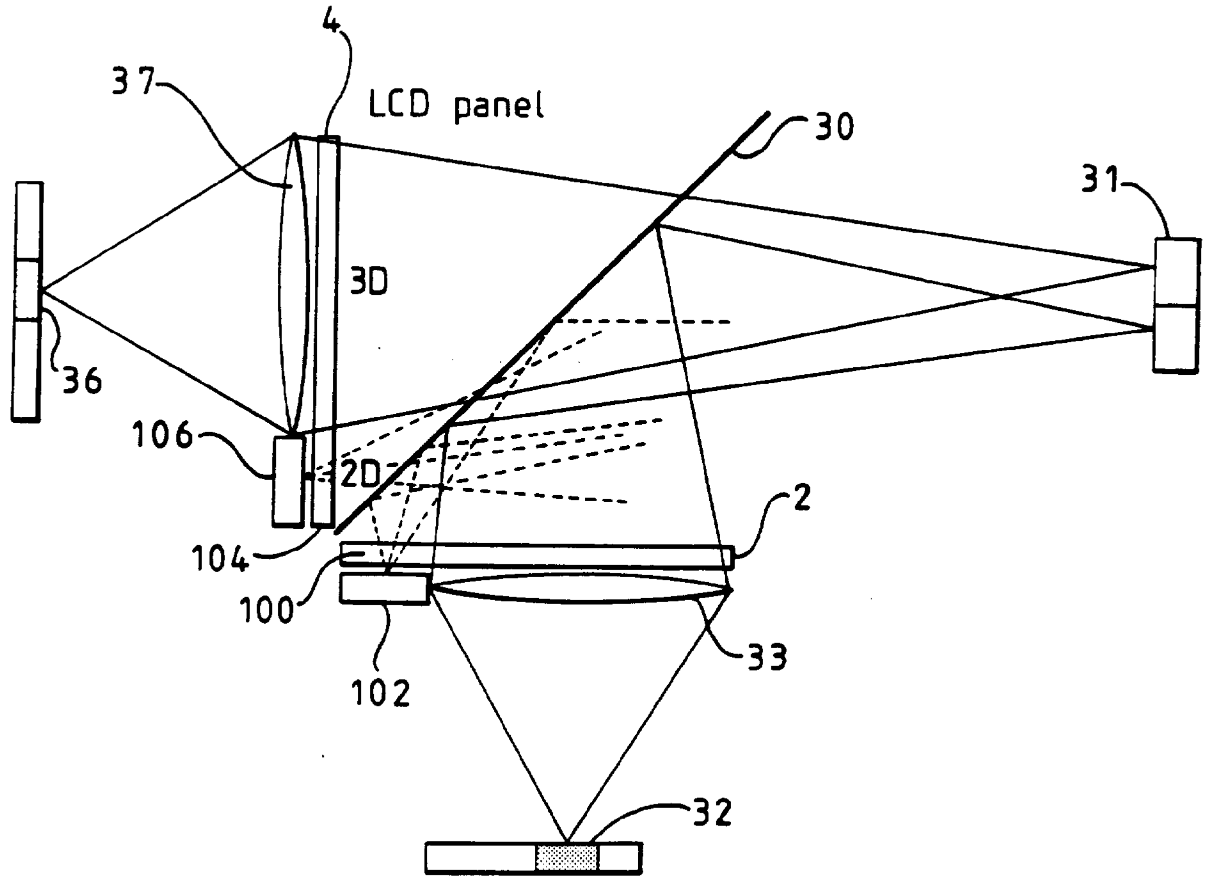


FIG 8b

FIG 9



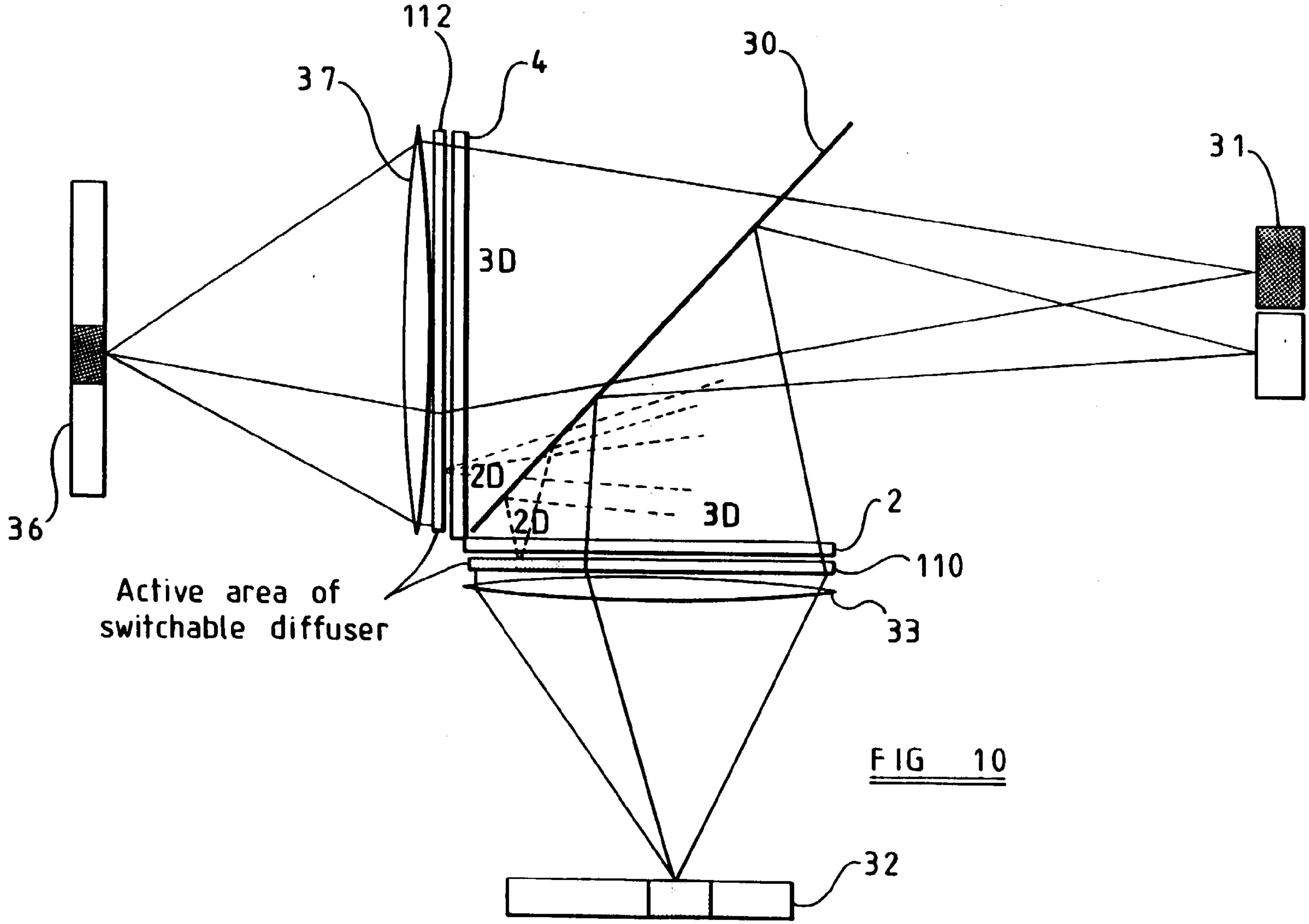

112
37
4
30
31
3D
36
2D
2D
3D
2
110
Active area of
switchable diffuser
33
32

FIG 10

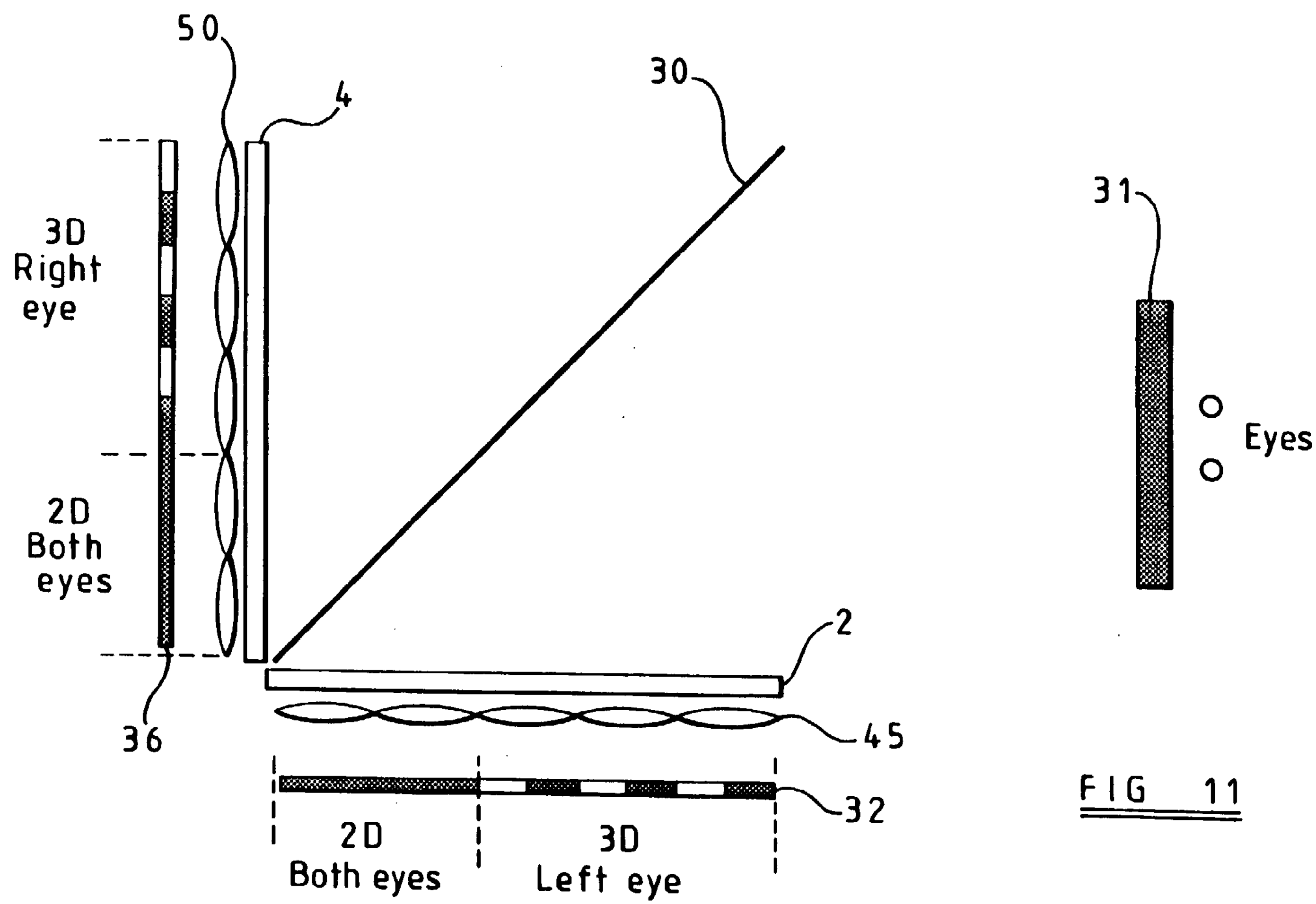

50
4
30
31
3D
Right
eye
2D
Both
eyes
Eyes
2
36
45
32
2D
Both eyes
3D
Left eye

FIG 11

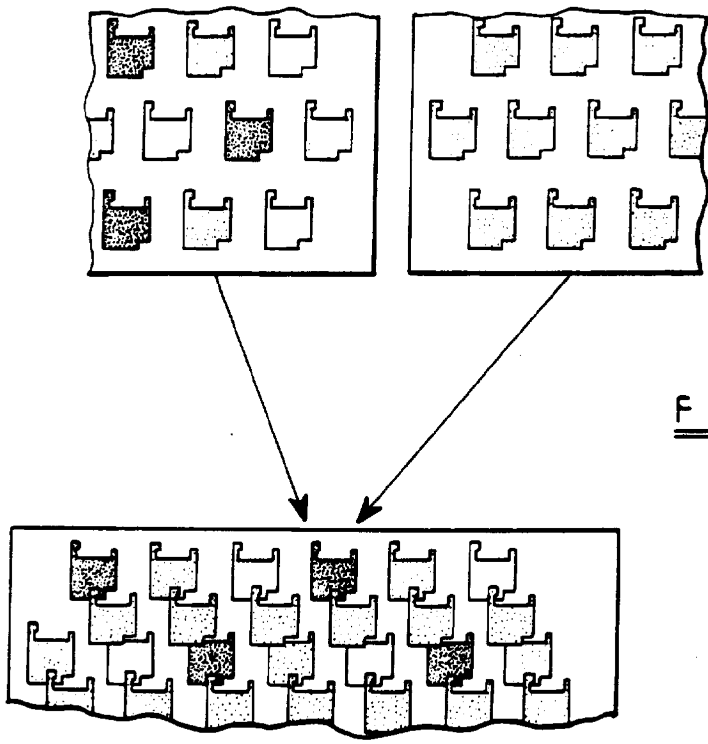


FIG 12

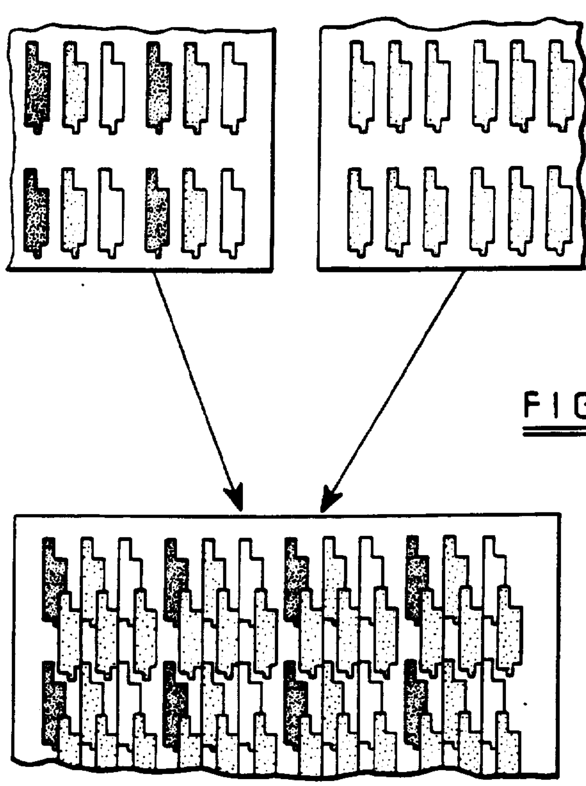


FIG 13

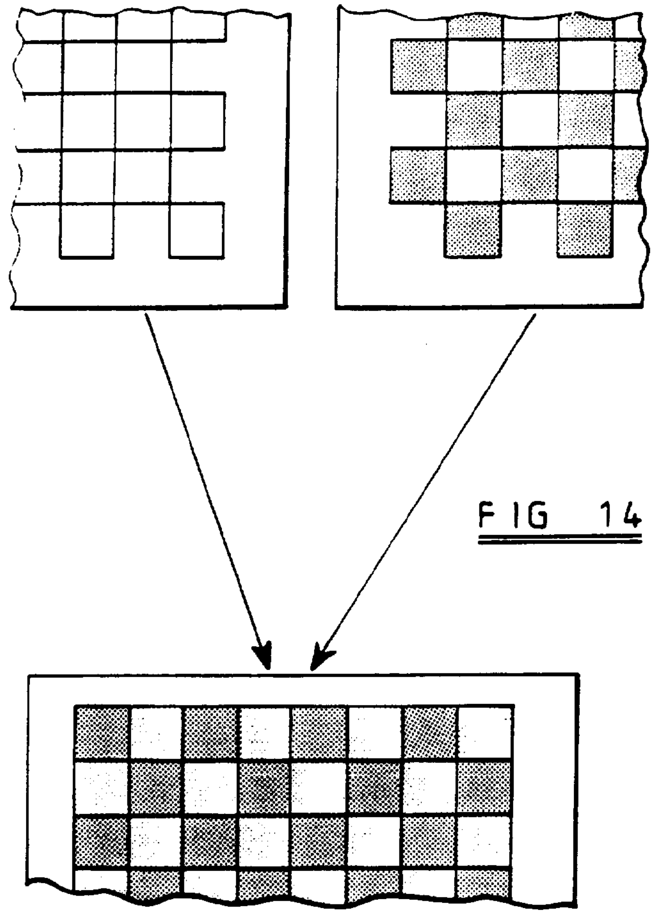
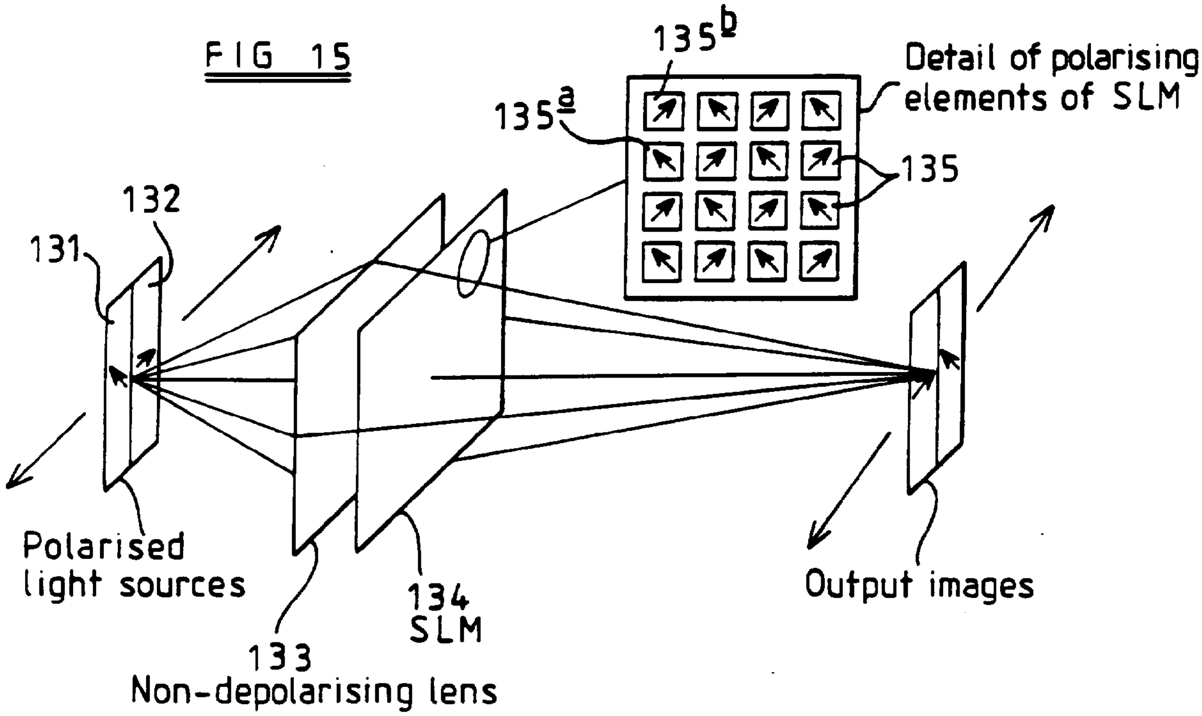


FIG 14

FIG 15


135b
135a
Detail of polarising elements of SLM
135
132
131
Polarised light sources
133
Non-depolarising lens
134
SLM
Output images

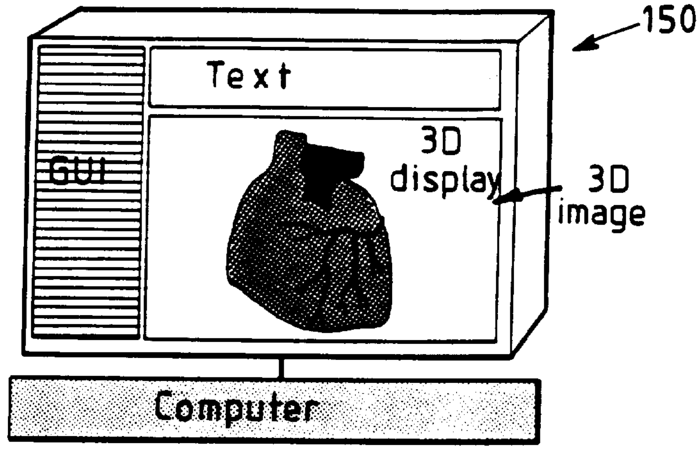


FIG 16

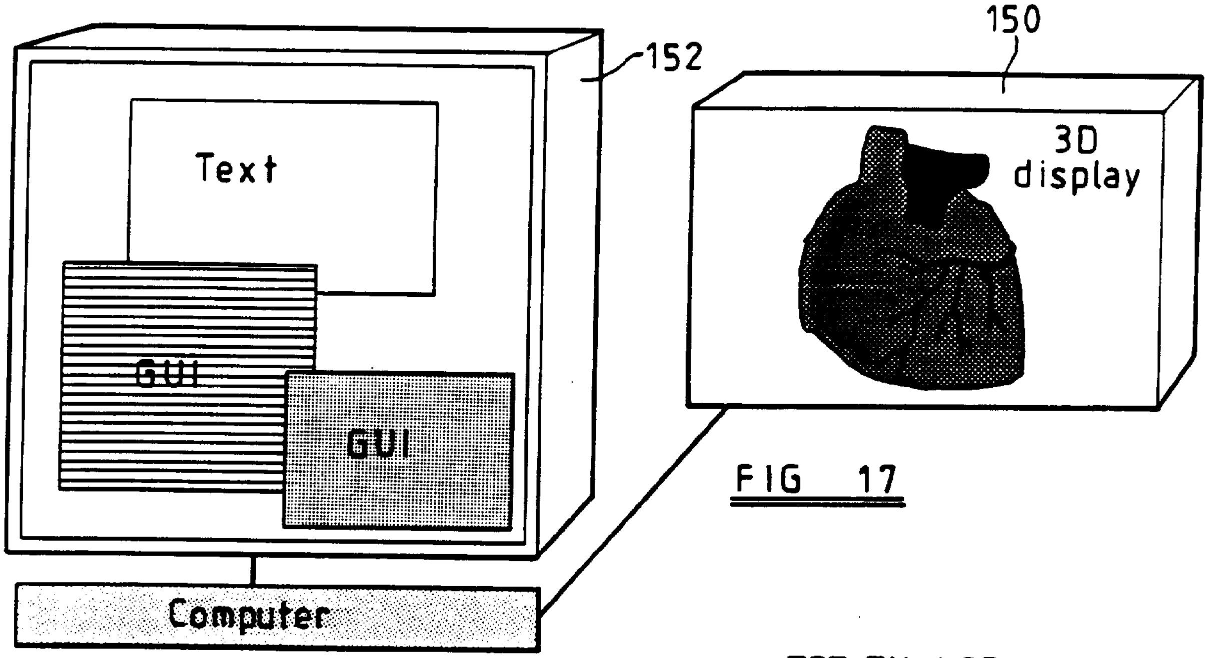


FIG 17

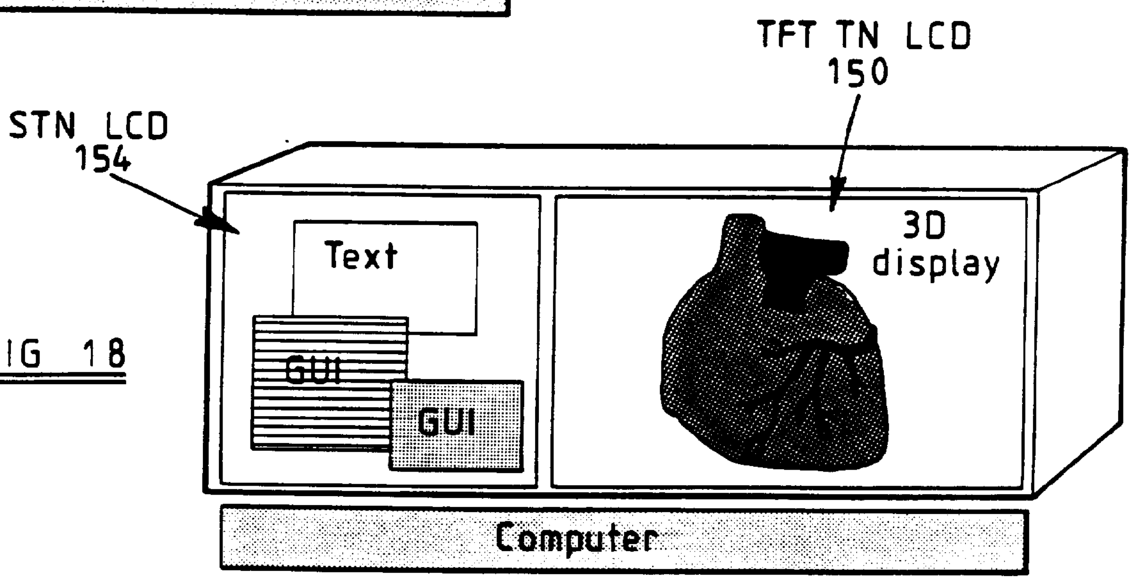


FIG 18

AUTOSTEREOSCOPIC DISPLAY HAVING HIGH RESOLUTION 2D MODE

The present invention relates to an autostereoscopic display that is switchable between a three dimensional mode and a two dimensional mode having an enhanced resolution.

A number of three dimensional (3D) display devices, such as those using a lenticular screen, may also be operated so as to display a two dimensional (2D) image. The resolution of such displays is the same in the 2D and 3D modes. However, some image data, such as text, needs, in general, to be presented with as great a resolution as possible in order to maintain legibility.

According to a first aspect of the present invention there is provided an autostereoscopic (three dimensional) display having a first resolution in a three dimensional display mode and a two dimensional display mode having a second resolution greater than the first resolution.

It is thus possible to provide an autostereoscopic display having enhanced resolution in a 2D mode. Advantageously the display may simultaneously display a 3D image and a 2D image. This may be of great benefit when a display is used as an output device of a computer.

Preferably the display comprises at least two spatial light modulators arranged such that, in a two dimensional mode of operation of the display, picture regions of the image produced by a first spatial light

modulator are interspersed with picture regions of the image produced by the or each other spatial light modulator thereby giving enhanced resolution in the two dimensional mode compared to the resolution in the autostereoscopic mode.

Preferably the display further comprises at least one beam combiner for combining the images produced by the first and second spatial light modulators.

Preferably the display produces a display output comprising a plurality of "windows", the windows being substantially contiguous at a nominal viewing position when in the autostereoscopic mode and being overlapping when in the two dimensional mode.

Preferably the spatial extent of the illumination source for each spatial light modulator is controllable, such that the illumination source has a first spatial extent when the display is operated in the autostereoscopic mode and a second spatial extent greater than the first spatial extent when in the two dimensional mode.

An autostereoscopic display operates by presenting different views to each eye of an observer. EP-A-0 602 934 (EP Application No 93310071.1 based on GB 9226272.4) discloses, amongst other things, a beam combiner type display. In a basic form, the display comprises a plurality of spatial light modulators each illuminated by a respective light source (which may comprise a plurality of light emitting elements). An imaging system is included such that images of the light sources modulated by the respective spatial light modulators are directed along predetermined directions and, more specifically, are formed at

"windows" at a nominal viewing position. Each of an observer's eyes are positioned in different windows and each window displays a different view.

For example, a system having two windows (which may form a cyclically repeating pattern) may be arranged such that the left eye observes the first window and the right eye observes the second window when in an autostereoscopic mode. Switching to a two dimensional mode causes the windows to become extended and overlapping (by virtue of extending the light sources) such that each of the observer's eyes simultaneously observes both the first and second windows.

The positions of the light sources with respect to the imaging systems may be varied so as to compensate for movement of the observer, the movement may involve physical translation of the light source or simulated movement such as controlling the position of a light transmitting region of an otherwise non-transmissive spatial light modulator adjacent a spatially extended diffuse light source. An example of an observer tracking display is disclosed in co-pending British Patent Application GB 9324703.9.

The at least two spatial light modulators may be illuminated via optical elements such as Fresnel lens or double lenticular screen amplifiers (such an amplifier is known per se, but is illustrated in Figure 4 of GB 9324703.9) or by a common light source. The light source may be movable with respect to the optical elements and the spatial light modulators. Alternatively the light source may comprise a plurality of light emitting elements which are individually controllable. The light emitting elements may be adjacent a plurality of lenses. As a further

alternative, the display may further comprise at least first and second light sources and optical elements for illuminating at least first and second spatial light modulators, respectively. Each of the first and second light sources may comprise a plurality of light emitting elements which are individually controllable.

In those arrangements having one or more light sources comprising a plurality of light emitting elements, the spatial extent of the light source can be controlled by varying the number of elements which are on simultaneously. The or each light source may comprise a further spatial light modulator adjacent an extended light source.

Advantageously the display may comprise at least two electrically controllable diffusing elements switchable between a substantially non-diffusing mode and a diffusing mode and optically arranged in series with respective ones of the spatial light modulators for controllably diffusing light incident on the spatial light modulators. The electrically controllable diffusing elements may be polymer dispersed liquid crystal panels. Each panel may be adjacent the associated spatial light modulator.

Alternatively the at least two spatial light modulators may be spatially multiplexed within a single spatial light modulator. Such an arrangement is described in a co-pending patent application. The co-pending application describes a display having first or second orthogonal polarisers associated with individual pixels in a chess-board like arrangement. The pixels arranged to pass a first polarisation of light display a first view whereas the pixels arranged to pass a second orthogonal polarisation of light display a second view. The spatial light

modulator is illuminated by non-overlapping sources of the first and second polarisations to image the first and second views to different eyes of an observer. The light source can be replaced by a source of diffuse non-polarised light or light polarised along a third direction resolvable into components along the first and second directions to give a high resolution 2D mode according to the present invention in which the light transmitted by each of the spatial light modulators is observable by both of the observer's eyes. As a further alternative the spatial extents of the sources of the first and second polarisations may be increased, for example by physically increasing the size of the light emitting areas or by using a diffuser, when in the 2D mode. The first and second lights may be circularly polarised.

The positions of the sources of the first and second polarisations of light may be movable so as to accommodate movement of the observer.

According to a second aspect of the present invention, there is provided a display comprising first display means for producing a three dimensional image at an image plane and second display means for producing a two dimensional image adjacent the three dimensional image and in the image plane.

The present invention will further be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram showing the pixel shapes on first and second display devices and how these are spatially related to give a high resolution 2D mode in a first embodiment of the present invention;

Figure 2 is a schematic diagram showing the spatial relationship between pixels of first and second display devices within a display constituting a second embodiment of the present invention;

Figure 3 is a schematic diagram showing the spatial relationship between pixels of first and second display devices within a display constituting a third embodiment of the present invention.

Figure 4 is a schematic diagram showing the spatial relationship between pixels of first and second display devices within a display having enhanced resolution in a horizontal direction and constituting a fourth embodiment of the present invention;

Figure 5a is a schematic diagram showing the illumination pattern of a display constituting a fifth embodiment of the present invention in a 3D mode, whereas Figure 5b shows the illumination pattern of the same display in a 2D mode;

Figure 6a is a schematic diagram showing the illumination pattern of a display operating in a 3D mode and constituting a sixth embodiment of the present invention, whereas Figure 6b shows the illumination pattern for the same device in a 2D mode;

Figure 7a is a schematic diagram showing a display having electrically controllable diffusing elements and constituting a seventh embodiment of the present invention and operating in a 3D mode, whereas Figure 7b shows the same display in a 2D mode;

Figures 8a and 8b are schematic diagrams showing a display constituting an eighth embodiment of the present invention operating in a 3D mode and a 2D mode, respectively;

Figure 9 is a schematic diagram of a display capable of simultaneously displaying a 3D image and a high resolution 2D image, and constituting a ninth embodiment of the present invention;

Figure 10 is a schematic diagram of a display constituting a tenth embodiment of the present invention;

Figure 11 is a schematic diagram of a display constituting an eleventh embodiment of the present invention;

Figures 12, 13 and 14 are schematic diagrams illustrating further arrangements of pixel shapes on first and second display devices and how these are spatially related to give a high resolution 2D display mode;

Figure 15 is a schematic illustration of a display having first and second displays spatially multiplexed within a single spatial light modulator and constituting a further embodiment of the present invention.

Figure 16 illustrates an autostereoscopic display displaying a mixture of 3D, 2D and graphical user interface information (GUI);

Figure 17 illustrates a display having a dedicated 2D display for displaying text, GUI and the like, alongside a 3D display; and

Figure 18 illustrates a display comprising a 3D display and a 2D display integrated into a common chassis and providing a common image plane.

Three dimensional autostereoscopic display devices, of the type described in EP 93310071.1 (Published as EP 0602934-A1) "Autostereoscopic directional display apparatus" combine images from first and second spatial light modulators (SLMs) with a beam combiner. Such an arrangement may be modified to produce a high resolution 2D display. Figure 1 schematically illustrates the pixel arrangement within the first and second SLMs 2 and 4, respectively. This pixel arrangement is typical of that found in thin film transistor LCD panels. As shown, each SLM is a liquid crystal display comprising a plurality of substantially rectangular pixels 6. A small region at the corner of each pixel contains a thin film transistor 8 for driving the respective pixel 6. The transistor 8 is typically covered by a black mask 10 which also separates adjacent pixels from one another. The pixels 6 may be arranged in rows of red pixels 12, blue pixels 14 and green pixels 16 so as to provide a colour display. The first and second SLMs 2 and 4 are identical. The regions of light modulated by the pixels 6 of the first and second SLMs 2 and 4 are arranged to be combined by a beam combiner such that the pixels of the second SLM are interspersed with, and, to an extent, non-overlapping with, the pixels of the first SLM, as shown in the composite image 20 of Figure 1. Such an arrangement requires the relative positions of the first and second SLMs 2 and 4 to be controlled to a tolerance of approximately 25 μm.

By control of appropriate information to each SLM, a high resolution 2D image may be produced. For example, two SLMs driven at the resolution of VGA (640 x 480 colour pixels) graphics systems could

generate a 2D image having, for example, a resolution of 1280 x 480 pixels.

The arrangement shown in Figure 1 has a region 20 of overlap between pairs of pixels in each line. The overlap can be removed by modifying the pixel configuration of the LCD panels, as shown, for example, in Figures 2, 3 and 4. In the display shown in Figure 2, the pixels 22 of the second SLM 4 are laterally and vertically offset with respect to the pixels 24 of the first SLM 2 such that no overlap occurs. Such an arrangement gives increased resolution in the horizontal and vertical directions. A similar arrangement is shown in Figure 3. The display shown in Figure 4 gives increased resolution only in the horizontal direction. The pixels 22 of the second SLM 4 are laterally offset with respect to the pixels 24 of the first SLM 2. However, the pixels 22 and 24 are not vertically offset with respect to one another.

Figures 5a and 5b show an embodiment of the present invention operating in 3D and 2D modes, respectively. Images presented to the first and second SLMs 2 and 4 are combined at a beam combiner 30 before presentation to an observer at a viewing region 31 comprising a plurality of windows 31a and 31b. The first SLM 2 is illuminated by a first illuminator 32 via a lens 33. The first illuminator 32 comprises a plurality of individually controllable light sources. Figure 5a shows one light source 34 of the first illuminator 32 illuminated, whereas the other light sources of the first illuminator 32 are unilluminated. Light from the first illuminator is directed towards the first SLM by the lens 33. The second SLM 4 is illuminated by a second illuminator 36 via a lens 37. The second illuminator 36 also comprises a plurality of individually

controllable light sources, only one of which is illuminated at a given time when the display is operating in a 3D mode.

Figure 5b illustrates the display of Figure 5a operating in a 2D mode. All of the light sources within the first and second illuminators are illuminated so as to cause the image formed by each SLM to be viewable by both eyes.

Figures 6a and 6b show another embodiment of the invention operating in 3D and 2D modes, respectively. The embodiment is similar to that shown in Figures 5a and 5b, and like reference numerals refer to like parts. Images presented to the first and second SLMs 2 and 4 are combined at a beam combiner 30 before presentation to an observer at a viewing region 31. The first SLM 2 is illuminated by a first illuminator 32 comprising a plurality of individually controllable light sources. As shown, the illuminator 32 is controlled such that a first light source 41 is illuminated whereas second and third light sources 42 and 43 are unilluminated. The pattern of illumination is repeated along the length of the illuminator 32. Light from the illuminator 32 is directed towards the first SLM 2 by an array of lenses 45. The second SLM 4 is illuminated by a second illuminator 36. As shown, a first light source 46 is un-illuminated, whereas second and third light sources 47 and 48 are illuminated. The illumination pattern is repeated along the length of the second illuminator 36. Light from the second illuminator 36 is directed towards the second SLM 4 via a second array of lenses 50.

The first and second SLM's are presented with image data corresponding to the views to be presented to the left and right eyes of an observer. The position of the illuminated elements of the first and second

illuminators 32 and 36 with respect to their respective lenses or lens arrays, and SLMs are such that the views for the left and right eyes are directed to different regions 52 and 54 within the viewing region 31 (comprising windows 31a, 31b and 31c in a repeating pattern). As shown in Figure 6a, the left eye 56 of an observer is within region 54 whereas the right eye 58 is within region 52. Thus the observer sees an autostereoscopic image.

In order to operate the display in a 2D mode, all of the light sources within the first and second illuminators 32 and 36 are switched on. Thus the image data on each SLM 2 and 4 is simultaneously presented to each of the observer's eyes.

The embodiment shown in Figures 7a and 7b has a single movable light source 60. The light therefrom is split in to first and second paths 62 and 64 by a beam splitter 66. The light in the first path 62 is deflected by a mirror 68 towards the first SLM 2. A lens 70 acts to direct the light towards the SLM 2 forming an image of the light source at the viewing region. A similar arrangement is provided for light in the second path 64. The light is directed from the beam splitter 66 towards the second SLM 4 via a second mirror 72 positioned at a slightly different angle (i.e. not parallel) to the first mirror 68 and a second lens 74. The images produced by the first and second SLMs 2 and 4 are merged by a beam combiner 30 and directed towards a viewing region 31. An observer at the viewing region will see an autostereoscopic image by virtue of observing one SLM with one eye and the other SLM with the other eye. A first electrically controllable diffuser 80 is positioned between the lens 70 and the SLM 2. Similarly, a second electrically controllable diffuser 82 is positioned between the lens 74 and the SLM 4. The diffusers 80

and 82 comprise a polymer dispersed liquid crystal panel. The diffusers 80 and 82 are controlled so as to be clear when in the 3D mode shown in Figure 5a and to be diffused when in the 2D mode shown in Figure 5b. The display may become dimmer when operating in a 2D mode due to the larger cone angle of the diffuse light. This can be compensated for by adjusting the brightness of the light sources.

In a further embodiment (Figures 8a and 8b) which is a modification of the embodiment shown in Figures 7a and 7b, an illuminator 84 comprising a plurality of individually controllable light sources is substituted in place of the light source 60. Furthermore, the electrically controllable diffusers 80 and 82 are omitted. Only a few of the light sources within the illuminator 84 are illuminated when in a 3D mode, whereas the entire illuminator is illuminated in a 2D mode. Furthermore, the illuminator 84 may be fixed or movable. As before, the images formed by the first and second SLMs 2 and 4 are presented to different regions within the viewing region 31 when in the 3D mode, whereas the images are presented simultaneously to each eye of a observer when in the 2D mode.

Figure 9 schematically illustrates a display capable of simultaneously displaying both 2D and 3D images in a first mode and a single high resolution 2D image in a second mode. The display can be considered as being a modification of the display shown in Figure 5. Each SLM 2 and 4 is illuminated via respective illuminators 32, 36 and respective lenses 33 and 37. However, a portion 100 of the first panel 2 is illuminated by a diffuse light source 102. Similarly a portion 104 of the second panel is illuminated by a diffuse light source 106. The images from regions 100 and 104 are combined by the beam combiner 30 to

create a high resolution 2D image. The images from the remainder of the SLMs combine to provide an autostereoscopic image.

Figure 10 shows an embodiment which is a variation on that shown in Figure 9. A switchable diffuser 110 is placed between the lens 33 and the first spatial light modulator 2. Part of the diffuser may be made diffusing such that the associated region of the SLM 2 becomes a source of a 2D image. A similar diffuser 112 is located between the lens 37 and the second SLM 4. Thus, when corresponding areas of the diffusers 110 and 112 are switched to a diffusing state, a high resolution 2D image can be generated in conjunction with the 3D image. Use of electrically controllable diffusers enables the 2D image to be positioned at any place in the display output.

Figure 11 illustrates a variation on the embodiment shown in Figure 6. The illuminator 32 and 36 can be controlled such that part of the illuminator is contiguously illuminated so as to provide a 2D image whereas the remainder of the illuminator is controlled to provide a 3D image.

Figures 12, 13 and 14 show alternative pixel patterns on the first and second SLMs 2 and 4. The patterns shown in Figures 12 and 13 are representative of some of the pixel configurations found in thin film transistor twisted nematic liquid crystal displays. The chessboard or checkerboard arrangement shown in Figure 14 enables a fill factor of substantially 100% to be achieved, thus giving a bright display.

In each of the embodiments described hereinabove, the spatial light modulators will display respective ones of the stereo-image pair (i.e. left

eye view and right eye view) when operating in a 3D mode. When the entity or part of the display is switched to a high resolution mode, the image data within the 2D view region is changed such that each display displays alternate pixels of the same view.

Figure 15 shows a display in which the spatial light modulator 134 is sub-divided into pixels 135a arranged to transmit light polarised along a first direction and pixels 135b arranged to transmit light polarised along a second direction orthogonal to the first direction. The first pixels 135a effectively form a first spatial light modulator interspersed amongst the pixels 135b of a second spatial light modulator.

The polarised light sources 131 and 132 emit light polarised along the first and second directions respectively. The light from the light sources is imaged through a lens 133 such that, in use, light from the first light source 131 impinges only on a first eye of an observer and is modulated by the pixels 135a of the first spatial light modulator, whereas light from the second light source 132 impinges only on a second eye and is modulated by the pixels 135b of the second spatial light modulator. The display can be used in a 2D high definition mode by illuminating the SLM 134 with diffuse non-polarised light such that all of the pixels cooperate to modulate the light passing therethrough to form a single image viewable by both eyes of the observer. Alternatively, the light source for use in the 2D mode may have a polarisation which is resolvable into components along the first and second directions, the components in these directions of substantially equal intensity.

In a further variant the spatial extent of each of the light sources 131 and 132 may be extended when in the 2D mode in a manner similar to that

described hereinabove with reference to Figure 5 of the accompanying drawings. A diffuser, similar to that described with reference to Figures 7 and 10, may also be used to allow switching between 2D and 3D modes.

The light sources 131 and 132 may be movable with respect to the lens 133 to allow observer tracking to be performed, as described in GB 9324703.9.

In many applications of 3D displays, such as computer aided design (CAD), information to be displayed can be divided into 3D information and two dimensional (2D) information. The 3D information is generally required to be graphical, may be in colour, and may represent movement. The 2D information may comprise any combination of a graphical user interface (GUI), text, button bars, icons, fixed colour or monochrome, with rapid movement mainly limited to a cursor.

Figure 16 illustrates one possible approach in which a 3D display 150 is used to display all of the information, for instance shown in the drawing as a 3D image, text, and GUI. However, by using a 3D display to display 2D information, the size of the 3D image is reduced as is the number of image pixels which are available for the 3D image. Further, frame cancelling increases as the GUI information imposes on the 3D frame. Frame cancelling is an effect where the frame of a 3D image display reduces the perceived effectiveness of the 3D image. This is reduced as the size of the image increases. Schematic diagrams of the optical systems needed to achieve the above is shown in Figures 9, 10 and 11.

Figure 17 illustrates another approach in which the 3D display 150 is used exclusively for the 3D image and a separate 2D monitor 152 is provided for displaying text, GUI, and the like. The 2D display 152 may comprise a high resolution cathode ray tube which may be used for data input with all its advantages as a flexible high resolution 2D work station display. However, this inhibits interactive design because an observer must keep looking between the displays 150 and 152.

Figure 18 illustrates another approach, in which one or more separate 2D displays 154 is integrated into the same chassis as the 3D display 150. The 2D display 154 may be embodied as a super-twisted nematic liquid crystal display whereas the 3D display 150 may be embodied using thin film transistor twisted nematic liquid crystal display technology. The displays 150 and 154 are arranged such that they provide a common image plain so that no observer re-accommodation is required between the displays.

Such an arrangement has various advantages. For instance, because no video information is required to be displayed by the 2D display 154, it may be embodied using super-twisted nematic technology which is relatively inexpensive. Further, a standard back light may be used for the 2D display. The display can be made as large as desired by incorporating as many individual displays as necessary. It is possible to provide a high resolution 3D image and high resolution GUI. Frame cancelling of the image by the GUI is reduced as there is no conflict between the 3D and 2D information. Standard liquid crystal display resolutions can be used for the 2D display 154. Where the 3D display 150 is of the type, for instance, shown in Figure 6 or the resolution of the 2D image can, for instance, be doubled by using two 2D display

panels with their outputs combined by a beam combiner. Displays of this type are compatible with observer tracking and it is possible to provide a compact display.

It is thus possible to provide an autostereoscopic display having a high resolution 2D mode.

CLAIMS

1. An autostereoscopic display having a first resolution in a three dimensional display mode and a two dimensional display mode having a second resolution greater than the first resolution.

2. A display as claimed in Claim 1, in which the display produces an output comprising a plurality of windows, the windows being substantially contiguous at a nominal viewing position when in an autostereoscopic mode and being overlapping when in a two dimensional mode.

3. A display as claimed in Claim 1 or 2, comprising at least two spatial light modulators arranged such that, in a two dimensional mode of operation of the display, picture regions of the image produced by a first spatial light modulator are interspersed with picture regions of the image produced by the or each other spatial light modulator thereby giving enhanced resolution in the two dimensional mode compared to the resolution in the autostereoscopic mode.

4. A display as claimed in Claim 3, in which the spatial light modulators are illuminated by respective light sources having a first spatial extent when the display is operated in the autostereoscopic mode and a second spatial extent greater than the first spatial extent when the display is operated in the two dimensional mode.

5. A display as claimed in Claim 3, in which the spatial light modulators are illuminated by a common light source.

6. A display as claimed in Claim 5, in which the common light source has a first spatial extent when the display is operated in the autostereoscopic mode and a second spatial extent greater than the first spatial extent when in the two dimensional mode.

7. A display as claimed in any one of Claims 4 to 6, in which the or each light source comprises a plurality of light emitting elements which are individually controllable.

8. A display as claimed in Claim 7, in which the spatial extent of the or each light source is controlled by varying the number of light emitting elements which are illuminated simultaneously.

9. A display as claimed in any one of Claims 3 to 8, further comprising at least two electrically controllable diffusing elements switchable between a substantially non-diffusing mode and a diffusing mode and optically arranged in series with respective ones of the spatial light modulators for controllably diffusing light incident on the spatial light modulators.

10. A display as claimed in Claim 9, in which the controllable diffusing elements can simultaneously have at least one diffusing region and at least one non-diffusing region.

11. A display as claimed in any one of Claims 4 to 8 or Claims 9 and 10 when dependent on any one of Claims 4 to 8, further comprising at least one imaging system for directing light from the or each light source along predetermined directions via a respective spatial light modulator, the or each light source being movable with respect to the at

least one imaging system so as to vary the directions when in an autostereoscopic mode.

12. A display as claimed in any one of Claims 3 to 11, further comprising at least one beam combiner for combining the images produced by the spatial light modulators.

13. A display as claimed in any one of Claims 1 to 4 or 7 to 11 except when dependent on Claims 5 and 6, comprising a first spatial light modulator arranged to selectively transmit light polarised in a first sense, a second spatial light modulator arranged to selectively transmit light polarised in a second sense, and a light source switchable between a first mode for producing first and second non-overlapping polarised lights polarised in the first and second senses, respectively, and a second mode for producing a light transmitted by both spatial light modulators.

14. A display as claimed in Claim 13, in which the first and second spatial light modulators are spatially multiplexed within a single spatial light modulator.

15. A display as claimed in Claim 13, in which the light produced in the second mode is unpolarised.

16. A display as claimed in Claim 13, in which the first and second senses are first and second directions and are orthogonal, and the second mode produces a light polarised along a third direction bisecting the first and second directions.

17. A display as claimed in Claim 13, in which the first and second senses are left handed circularly polarised and right handed circularly polarised, respectively.

18. A direct view display comprising an autostereoscopic display having a two dimensional display mode of higher resolution than the autostereoscopic mode as claimed in any one of the preceding claims.

19. A display comprising first display means for producing a three dimensional image at an image plane and second display means for producing a two dimensional image adjacent the three dimensional image and in the image plane.

Patents Act 1977 **I miner's report to the Comptroller under Section 17** **(The Search report)**	Application number GB 9425761.5
Relevant Technical Fields (i) UK Cl (Ed.N) H4F (FDD) (ii) Int Cl (Ed.6) H04N (13/00, 13/04, 15/00)	Search Examiner MR J M McCANN Date of completion of Search 15 FEBRUARY 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) WPI	Documents considered relevant following a search in respect of Claims :- 1

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Category	Identity of document and relevant passages	Relevant to claim(s)
A	US 4630097 (A M MARKS) see abstract	1

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